2

NASA TECHNICAL TRANSLATION NASA TT F-15,047

MEDICAL ASPECTS OF THE SAFE DESCENT AND LANDING OF A SPACECRAFT ON THE EARTH AND OTHER CELESTIAL BODIES

V. G. Volovich

(NASA-TT-F-15047) MEDICAL ASPECTS OF THE SAFE DESCENT AND LANDING OF A SPACECRAFT ON THE EARTH AND OTHER CELESTIAL BODIES (Techtran Corp., Silver Spring, Md.) ~~22~~ 25 p HC $3.25 CSCL 05E G3/05

N73-29053

Unclas 11320

Translation of "Meditsinskiye aspekty bezopasnogo spuska i posadki korabley na zemlyu i drugiye nebesnyye tela," Vol. 3, Part 4, Chapter 3 of: Osnovy Kosmicheskoy Biologii i Meditsin [Foundation of Space Biology and Medicine], Moscow, Academy of Sciences USSR, 1973, 40 pages.

N 70K. ONLY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546 AUGUST 1973

MEDICAL ASPECTS OF THE SAFE DESCENT AND LANDING OF A SPACECRAFT ON THE EARTH AND OTHER CELESTIAL BODIES

TABLE OF CONTENTS

Crew life-support systems for landing (splashdown) in unpopulated areas	pages 1-7
References	pages 8-9
Notes and abstracts of papers	pages 10-22

MEDICAL ASPECTS OF THE SAFE DESCENT AND LANDING OF A SPACECRAFT ON THE EARTH AND OTHER CELESTIAL BODIES

Crew life-support systems for landing (splashdown) in unpopulated areas

In the event of an unexpected emergency situation requiring immediate abortion of a flight, the spacecraft may land in an area other than the one planned, in an uninhabited region or in the ocean, when it returns to earth. The modern equipment of search crews will make it possible in most cases to locate the spacecraft rapidly if it has landed (splashed down) far from bases, airports or populated areas. However, in some cases the arrival of help may be delayed due to a breakdown or radio communications with the spacecraft, weather too bad to allow flight in the landing area, etc. In this case the cosmonauts will be on their own for some period of time and will have to use all possible means of maintaining life and health until search groups arrive.

The favorable outcome of independent existence, as indicated by many authors, will depend on a number of factors: knowledge of how to survive, ability to adjust to the environment, ability to use correctly the emergency supplies provided. The climatic and geographic conditions of the landing site will play an important role (Pyneyev, N. K., 1957; Arsen'yev, V., 1968; Volovich, V. G., 1969, etc.).

The emergency landing of a spacecraft, depending on the orbit, may occur in practically any geographic zone of the globe: on the ice of the Central Polar Basin, in the tundra and taiga, in mountains and impenetrable jungles, in the torrid deserts of the south and in the vast expanses of the ocean (Volynkin, Yu. M. et al, 1961; Gorlov, O., Borisov, V., 1961). Each has its own characteristic features of climate, relief, vegetable and animal life. /2

The latter will determine the specifics of the mode of behavior, methods of obtaining water and food, construction of temporary shelters against storms, heat and cold, illness and measures to prevent against it, methods of moving about in the area, etc.

It is natural that the degree of importance of various parameters will vary as a function of the geographic locale. Thus, the most important thing in the desert will be to provide protection against solar radiation and to provide water; in the arctic, the most important problem is the fight against cold, etc.

Experience has shown that human beings can survive under the most severe natural conditions. However, a person who is unaccustomed to them and finds himself exposed to these conditions by accident will be much less likely to survive than the persons who live there all the time. Therefore, it is very important to know the limits of physiological and psychic resistance of man to

the influence of extremal environmental factors under survival conditions, what methods of protection against them are most effective, and what measures are most effective as far as survival is concerned.

These data can only be obtained by studying the viability of man in a situation resembling real conditions of independent existence with limited supplies of water and food. Such experiments make it possible, on the one hand, to study the nature of the influence of extreme environmental factors on the human organism and the limits of tolerance, and on the other hand, to develop appropriate recommendations for various aspects of survival (Arsen'yev, V., 1968; Volovich, V., Vsevolodov, A., 1969; Volovich, V. G., 1969 and others).

A number of such tests have been conducted in the Soviet Union in recent /3
years. A study of survival conditions for an aircraft crew following an emergency landing in areas with a severe dry climate was performed in the deserts of Central Asia. Those taking part in the experiment, provided with emergency supplies, were sent out to the sand dunes with improvised tents made of their parachutes to protect them against the sun and ate a low-calorie emergency ration for several days (approximately 900 kcal). The daily water consumption, depending on the experimental conditions, was 1-2.5 liters. The air temperature in the shade reached 46-48° C. At these temperatures the thermal regulatory system operates under considerable stress and as a result dehydration of the organism may occur as the result of intensive water loss with the perspiration. However, water loss can also decrease under these conditions as a result of a more economic use of food, limitation of physical activity, staying in the shade, wearing light outer clothing to cut down the influx of external heat, etc.

Experiments performed in the desert have made it possible to obtain some interesting data on water-salt exchange, and to test several recommendations concerning survival under desert conditions (Vovolich, V., Vsevolodov, A., 1969).

The work of Soviet researchers on the problem of human survival in the tropical zone of the ocean involving independent drifting in lifeboats and liferafts is of considerable interest. As soon as the spacecraft splashes down in the ocean, the crew is faced with a number of problems whose solution will determine the favorable outcome of their independent existence. The high air /4
and water temperature, considerable solar radiation, constant rolling, lack of fresh water, possibility of attack by sharks, etc. can all influence the survival of those in distress.

The practical solution of many of these problems can only be obtained by simulating conditions of independent existence under actual ocean conditions. With this goal in mind, a group of Soviet investigators performed experiments in which individuals stayed aboard a liferaft in the tropical zone of the ocean. Those taking part in the experiments used an emergency food ration to obtain nutrition, reducing their water consumption to 1 liter per day. During the medical examinations that were conducted several times a day, the changes in the general condition were determined, the pulse rate and respiration were measured, along with the arterial pressure, gas exchange, muscle tone, etc.

The daily amounts of urine were measured and a portion of it was saved for subsequent laboratory determination of its content of potassium, calcium, sodium, chlorine, phosphorus, total nitrogen, etc. Constant supervision of the state of health of the subjects made it possible to conduct continuous observations of the processes that take place in the organism during exposure to extreme environmental factors under conditions of survival at sea (Volovich, V. G., 1969).

As many authors have pointed out, the most serious problem on which survival at sea depends is obtaining drinking water (Matuzov, N. I., 1961; Volovich, V. G., 1967, 1969 etc.). According to the data from Soviet and foreign authors, sea water cannot be used for drinking because of its high content of various salts (30-36 mg %). Nearly 75-85% of the sea water ingested by the /5
organism must be excreted in order to get rid of the salts through the kidneys. Therefore, in order to satisfy the liquid requirements of the organism, it is necessary to drink 8-10 liters of sea water daily. This is practically impossible, since it can cause irritation of the gastrointestinal tract, irritation of the kidneys and central nervous system (Matuzov, N. I., 1961; Volovich, V.G., 1967 etc.).

The drinking of sea water can only be recommended in small amounts, with a dilution of 1:3 or 1:6 to make up for the loss of salts by the organism resulting from excessive vomiting produced by seasickness (Matuzov, N.I., 1961 and others).

The problem of obtaining water at sea can be solved in two ways: obtaining fresh water from sea water by means of chemical preparations or solar stills, collecting precipitation (dew, rain), using fluids obtained by squeezing out the flesh of fish that have been caught (fish juice) or taking measures to reduce the loss of water through perspiration. The latter include limitation of physical activity, remaining in the shade beneath an improvised tent, moistening the clothing, taking baths in sea water (Pyneyev, N. K., 1957; Merenov, I. V., Shmukler, A. L., 1963; Volovich, V. G., Uskov, V. N., 1967; Volovich, V. G., 1969 and others).

To check the efficiency of these measures a group of individuals was placed in an open boat at temperatures of 45-50°C in the sun. The water losses were determined by hourly weighing. The studies showed that the exposed human being loses an average of 350-600 grams of water each hour under these conditions. When the clothing is wet with sea water, the water losses drop to 100-150 /6
grams per hour. In the case of individuals who spent several hours beneath an improvised tent the water losses were approximately 200-300 grams per hour (Volovich, V. G., Uskov, V. N., 1967; Volovich, V. G., 1969).

The studies which were performed once again confirmed the importance of maintenance of a correct thermal regime and the adoption of preventive measures to reduce water losses to a minimum and ensure a certain degree of thermal comfort under the conditions which exist during a stay aboard floating rescue craft.

Sharks may pose a serious danger to cosmonauts aboard a lifeboat at sea. Regardless of the fact that many tests have been carried out regarding protective measures against marine predators, they still have not been perfected.

Nevertheless, a shark repellent made of a mixture of nigrosine and copper acetate is widely used. However, the tests in the field performed by Soviet researchers did not confirm the effectiveness of this repellent. Sharks attacked the bait which was placed in the center of a protective zone formed by several packets of repellent. In addition, in the opinion of Soviet authors powdered repellents cannot be considered reliable for other reasons as well: they are not designed for multiple application, the protective zone is usually rapidly dissipated by surface currents and finally the timely use of the repellent may be complicated by the fact that the individual detects the attacking shark at a short distance and the time between his observation of the predator and the solution of the repellent will be insufficient (Volovich, V. G., 1969).

Data obtained under natural conditions will unquestionably provide considerable material both on the general physiological level and in the practical sense, making it possible to estimate accurately the significance of the active factors, predetermine the anticipated reactions of the organism and accordingly work out the most adequate measures for prevention and protection for survival conditions.

A very important condition for the favorable outcome of survival is providing the crew of the spacecraft with a portable emergency supply --PES. Such a PES has low weight and volume and must contain the maximum amount of valuable objects which can be used by the individual under conditions of independent existence. These include radio-signalling means, camping equipment, an inflatable raft, water supplies and food provisions (Alekseyev, S. M. et al, 1961; Gorlov, O., Borisov, V., 1961; Pyneyev, N. K., 1967). The pilot-cosmonauts who flew aboard the "Vostok" spacecraft were equipped with special PESes in the event of an emergency landing other than at the point specified. This type of PES was a soft container with a frame, located in the base of the ejection seat. The portable emergency supply consisted of a radio transmitter with its own power supply, allowing 2-way communication over a distance of several thousands of kilometers, cartridges for signalling by day and night in order to communicate with search aircraft and helicopters. A portable hotplate with a supply of dry fuel and wind and water resistant matches made it possible to prepare hot food and drink under field conditions. In order for the cosmonauts to be able to determine their position, the PES contained a specially designed sextant and a small-scale map. The supply of water in the PES was designed for a stay of several days in the desert; in the case of a landing in the ocean the cosmonaut could obtain an additional supply of drinking water by using briquettes of a chemical distilling agent. If he were to land in the water, the cosmonaut could use a single-place rubber boat, which inflated automatically. The PES was equipped with a medicine chest for administering first aid, containing supplies of the necessary medicines and bandages (Volynkin, Yu. M. et al, 1961). /7 /8

In putting together the portable emergency supply special attention was given to the emergency food ration. As a rule, it is made of high-calorie products which can be used either after cooking or in the dry form. However, the shortage of space in the PES container makes it necessary to use preserved products which have the maximum caloric content with minimum weight and volume. Many authors feel that the emergency food ration must strictly maintain the ratio between the basic nutrient substances (Bychkov, V. P. et al, 1963).

However, this point of view is not considered to be generally accepted. Others proceed on the basis of the fact that a stay under independent living conditions is relatively short and therefore an increase in the caloric content of the ration is more important than strict observation of the ratios between the food components: fats, proteins and carbohydrates. This view concerning the principles of the makeup of the emergency food ration was supported by the successful testing of a ration which was intended for regions with a cold climate. In this ration, in comparison with the regular one, by reducing the carbohydrates from 711.4 to 627.7 grams, the amount of protein was increased from 141.1 to 184.5 grams and the fats from 179.8 to 279.8 g. This made it possible to increase /9 the caloric content of the ration from 4654.0 to 5930.0 kcal. In a test performed under laboratory conditions one group of individuals was fed the experimental ration and the others received a regular ration for 7 days. As a result of the experiment, the average weight loss among the subjects fed the experiental ration was 1.2-2.9 kilograms, while the subjects in the second group lost 1.9-3.5 kilograms. Despite the increased content of fat and protein in the ration, none of the subjects showed any indications of disturbances of fat and protein metabolism, as indicated by the data from laboratory studies of the urine and blood. In addition, those who had eaten the experimental ration showed a decrease in the amount of total nitrogen excreted with the urine (Udalov, Yu. F., 19619.

The designers of other emergency rations have given preference to carbohydrate products. We know that the energy consumption of the organism during subcaloric nutrition is made up through the deposits of fat. The use of endogenic fat is accompanied by the formation of unoxidized products (acetone, beta-oxyoleic adid). In order to have a more complete utilization of endogenic fat it is necessary to have an additional amount of readily assimilated carbohydrates, no less than 60-70 grams per day (Logatkin, M. N., 1963). This was used as the basis for the development of a diet proposed by a group of authors--Kamarevtsev, L. N., Pobol', Ye. P. and Kumanichkin, S. D.,(1960). This diet, intended for survival at sea, was composed of sugar and vitaminized candy drops. To test the ration, 16 sailors spent 4 days in inflated rafts at air temperatures of 14-19°C with a water temperature of 15°C. On the first day the subjects did not receive any food. Beginning the second day, the crew of the first raft was given the experimental ration, consisting of 50 grams of sugar and 100 grams of candy containing 225 mg of vitamin C, 5 mg of vitamin B_1, /10 5 mg of vitamin B_2, 2.5 mg of vitamin B_6, 10 mg of vitamin PP, 25 mg of folic acid, 25 mg of pantothenic acid and 10 mg of paraaminobenzoic acid. The caloric content of the ration was 600 kcal. The sailors aboard the second raft received 150 grams of candy made from maltose. The subjects aboard the third raft were fed concentrates, bread, butter, and received 1700 kcal per day. The water ration for all 3 groups was limited to 0.5 liter per day. Medical examination of the subjects involved checking the cardiovascular and respiratory systems, in conjunction with a number of analyses aimed at determining the urinary content of total nitrogen, vitamins, amino acids, [word misspelled] oxygen, chlorides, creatinine and acetone. The results of the examinations which were performed after the end of the experiment showed that the most significant weight losses occurred among the sailors on the first raft, i.e., those who had been fed the experimental ration; the average weight loss was 4.5 kg. The sailors on the second raft lost an average of 3.7 kg. The subjects who had

been fed a ration with a relatively high caloric content lost an average of 0.5 kg. In addition, those who had been on the experimental diet showed a more pronounced decrease in the amount of nitrogen, aminoacids and total urinary nitrogen, indicating a better retention of proteins by the organism. In addition, all showed an improved vitamin supply situation, as a result of active administration of vitamins. Hence, this ration was found to be the best for conditions of independent existence aboard liferafts at sea.

Another subject which is of great interest as far as solving problems of designing emergency rations is concerned consists of the so-called lyophilized products, i.e., those which have been dehydrated in a vacuum at low temperature. This method makes it possible to reduce the weight and volume of the products /11
considerably through the removal of moisture, which is very important for any emergency ration, thereby retaining its caloric content, taste and nutrient characteristics. In this way, the energy of the product per unit weight and volume will be considerably increased. Such a ration was devised by a group of authors in 1963. It consisted of tablets of a powdered mixture of lyophilized products. Mixture No. 1 was prepared from plums, cream cheese and milk mixed in proportions of 1:1:1; mixture No. 2 contained cream cheese, plums and sugar mixed in the proportion of 5:5:1; mixture No. 3 consisted of plums, nuts, milk and sugar in a proportion of 5:5:11:1 and finally mixture No. 4 was made from beef, white sugar and plums in the proportion 6:4:5. The ration was supplemented with 300 grams of sugar, 300 grams of chocolate and 18 dragees containing vitamin A 1650AE, B_1- 1 mg, B_2 No. 1 mg and C- 25 mg each. The ration consisted of 3 daily meals, each of which was divided into 4 parts -- breakfast, brunch, lunch and dinner. The entire ration and the individual portions were packed in plastic film. The energy value of the ration weighing 1475 grams was 6950 kcal. The ration contained 241.0 grams of protein, 338.8 grams of fat and 685.8 grams of carbohydrates. After eating the ration for 4 days under laboratory conditions, the subjects lost about 1 kg on the average, while the weight of one subject remained unchanged.

The medical examination of the subjects following the experiment failed to reveal any kind of changes in the functions of the cardiovascular and respiratory systems.

Hence, the laboratory experiments confirmed the desirability of using lyophilized products in designing emergency rations. Providing cosmonauts with /12
portable emergency supplies will always be very important as far as solving survival problems is concerned. However, the most important aspect will be preparing the crew for how they should act under conditions of independent existence. Knowing how to do this, being able to use for their own needs everything offered by the environment, resourcefulness and resolution will govern the outcome of survival (Arsen'yev, V., 1968; Pyneyev, N. K., 1957; Volovich, V. G., 1969 and others).

The more difficult the conditions under which the spacecraft crew finds itself following an emergency landing (splashdown), the shorter the survival time will be. This means that the search organization must be very efficient.

Being equippped with modern equipment for transportation, range-finding, and radio communications will make it possible to render assistance to the cosmonauts in distress at practically any distance from the base. Experience gained in aviation indicates the possibility of rendering assistance and evacuating survivors practically in any location that is difficult to reach: forest massifs, swampy areas, mountains, the open sea, from drifting ice, etc. (Chelushkin, K.A. et al, 1959; Gur'yanov, A. A., 1966, and others).

When there are no landing areas for the search aircraft to use near the spacecraft, aid can be rendered by parachute groups equipped with the necessary supplies, water and food. To render medical assistance, such groups include physicians equipped for this purpose. After appropriate parachute training, /13 the physicians can land even under the most difficult conditions of terrain: in the taiga, at sea, on the ice of the Central Polar Basin (Volovich, V. G., 1957, 1961). Paramedics have been used repeatedly only during the landing of the "Vostok" spacecraft. As a rule, they were the first to reach the cosmonauts, carried out medical examinations and when necessary were able to render invaluable medical assistance to the crew of the craft (Volynkin et al, 1964, 1965).

The necessity for maintaining the vital activity of cosmonauts under survival conditions at the highest level possible calls for further expansion of work into all aspects of the problem. Complex studies conducted in laboratories and under field conditions have made it possible to answer a number of questions which life poses to man when he is on a one to one basis with nature, fighting it with his knowledge, skill and courage.

References

1. Alekseyev, S. M., Ya. V. Balkind, A. M. Gershkovich, V. S. Yeremin, A. S. Povitskiy and N. L. Umanskiy, "A Portable Emergency Supply," *Sovremennyye Sredstva Avariynogo Pokidaniya Samoleta* [Modern Methods of Landing an Aircraft in an Emergency Situation], Moscow, Voyenizdat, pp. 392-396, 1961.
2. Arsen'yev, V., "Before and After the Accident," *Komsomol'skaya Pravda*, No. 99 and 100, 1968.
3. Bychkov, V. P., A. S. Ushakov, Yu. I. Kondrat'yev and A. G. Kasatkina, "Emergency Supply of Dry Products in a Polymer Pack," *Voyenno-Meditsinskiy Zhurnal*, No. 10, pp. 70-73, 1963.
4. Chelushkin, K. A., A. A. Gur'yanov, L. Ya. Lokhmakov and A. A. Mel'nik, *Evakuatsiya Ranenykh i Bol'nykh s Korabley VMF i Trudnodostupnykh Mest Vertoletami* [Evacuation of the Wounded and Sick from Navy Ships and Inaccessible Places by Helicopter], Sevastopol', 1959.
5. Gorlov, O. and V. Borisov, *Zhizn' v Kosmose* [Life in Space], Moscow, Sovetskaya Rossiya Press, 1961.
6. Gur'yanov, A. A., "Evacuation of the Injured from Forest Massifs by Helicopter," *Voyenno-Meditsinskiy Zhurnal*, No. 1, pp. 13-16, 1966.
7. Komarevtsev, L. N., Ye. P. Pobol',and S. D. Kumanichkin, "Feeding the Crew of a Spacecraft Under Emergency Conditions," *Voyenno-Meditsinskiy Zhurnal*, No. 1, pp. 74-77, 1960.
8. Logatkin, M. N., "Some Characteristics of the Utilization of Endogenic Fat During Partial Starvation and Physical Stress," *Voprosy Pitaniya*, No. 5, pp. 27-33, 1963.
9. Matuzov, N. I., "The Possibility of Human Survival at Sea Without Supplies of Food and Water," *Gigiyena i Sanitariya*, No. 5, pp. 76-81, 1961.
10. Matuzov, N. I., "Some Problems of Saving the Lives of Those Who Have Suffered Disasters at Sea," *Voyenno-Meditsinskiy Zhurnal*, No. 7, pp. 63-68, 1961.
11. Merenov, I. V. and A. L. Shmukler, *Naduvnye Spasatel'nye Sredstva Na More* [Inflatable Rescue Devices at Sea], Moscow, Oborongizn Press, 1963.
12. Pyneyev, N. K., *Deystviya Ekipazha Samoleta, Vynuzhdenno Popavshego v Bezlyudnuyu Mestnost'* [The Actions of the Crew of an Aircraft Forced to Land in an Unpopulated Area], Moscow, Voyenizdat, 1957.
13. Udalov, Yu. F., "A Ration with Minimum Weight," *Voyenno-Meditsinskiy Zhurnal*, No. 3, pp. 62-64, 1961.
14. Volynkin, Yu. M., Yu. A. Gagarin, A. M. Genin, O. G. Gazenko, V.I. Yazdovskiy, V. G. Volovich et al, "A Portable Emergency Supply," *Pervyye Kosmicheskiye Polety Cheloveka* [The First Manned Space Flights], USSR Academy of Sciences Press, pp. 55-56, 1961.
15. Volynkin, Yu. M., O. G. Gazenko, A. M. Genin, V. G. Volovich et al,"The Results of the Search for Bykovskiy," *Vtoroy Gruppovoy Kosmicheskiy Polet* [The Second Group Space Flight], Moscow, Nauka Press, pp. 181-200, 1965.
16. Volynkin, Yu. M., A. M. Genin, O. G. Gazenko, V. G. Volovich et al, "Finding the Landing Site of the Cosmonauts," *Pervyy Gruppovoy Kosmicheskiy Polet* [The First Group Space Flight], Nauka Press, pp. 104-107, 1964.
17. Volovich, V., and A. Vsevolodov, "Plus 46 in the Shade," *Vokrug Sveta*, No. 1, pp. 2-6, 1969.

18. Volovich, V. G., "A Jump at the North Pole," *Sportivnay Zhizn' Rossii*, No. 11, pp. 22-23, 1961.
19. Volovich, V. G., "On a Raft on the Ocean," *Vokrug Sveta*, pp. 2-9, 1969.
20. Volovich, V. G., "Some Questions of Water Exchange in Man Under Conditions in the Tropical Zone of the Ocean," *Voyenno-Meditsinskiy Zhurnal*, No. 6, pp. 50-52, 1967.
21. Volovich, V. G., *Tridtsatyy Meridian* [The Thirtieth Meridian], Moscow, Molodaya Gvardiya Press, 1967.
22. Volovich, V. G., *God na Polyuse* [A Year at the Pole], Moscow, Sovetskiy Press, 1957.

Alekseyev, S. M., Ya. V. Balkind, A. M. Gershkovich, V. S. Yeremin, A. S. Povitskiy and N. L. Umanskiy, "A Portable Emergency Supply," from the the book *Sovremennyye Sredstva Avariynogo Pokidaniya Samoleta* [Modern Methods of Landing an Aircraft in an Emergency Situation], Moscow, Oborongiz, pp. 392-396, 1961.

A portable emergency supply, the PES, has been developed for use in cases of emergency landing of an aircraft in an unpopulated area or at sea, for purposes of sustaining the life of the crew under conditions of independent existence. The emergency kit includes the following: a radio transmitter with a built-in power supply, means of visual signalling, supplies of water and food, a medicine chest, and a number of items of camping equipment (knife, folding hotplate with fuel, flashlight, compass, etc.). In case of a landing in water, the PES contains an inflatable rubber liferaft(with automatic inflation). For flights over the desert, the raft may be replaced by canisters of water. The emergency supplies are located in a watertight container which has positive buoyancy. The total weight of the PES is 16 kg. The PES is fastened to the shrouds of the parachute. To facilitate landing (splashdown) the PES may be unfastened and suspended on a kapron line 12-15 meters long.

Arsen'yev, V., "Before and After the Accident," *Komsomol'skaya Pravda*, No. 99 and 100, 1968. /17

The article presents some data on laboratory experiments aimed at investigating questions of survival and rescue of aircraft crews who have made a forced landing in an unpopulated area in various climatic zones of the earth. Special attention is devoted to the timeliness of the problem, and the need for a scientific approach to the solution of problems of vital activity of man under conditions in which he is exposed to extreme environmental factors. A considerable percentage of the scientific activity of the laboratory was taken up by natural studies and tests of emergency supplies and equipment for the crews of aircraft which were carried out in the desert, on the ocean, in the taiga, arctic, etc. The special task with which these studies dealt was checking the possibility of independent existence of man under these conditions with a limited supply of survival equipment. The final goal of these experiments was to work out appropriate recommendations for further improvement in emergency-rescue equipment and also to study the proper behavior of the crews of aircraft who find themselves required to survive under unfavorable climatic conditions. The article goes into great detail concerning natural studies that were conducted in the taiga. For a certain period of time, the researchers lived in the taiga, ate the subcaloric rations, built shelters out of the materials they had at hand as well as their parachutes, and made trips in the taiga.

Bychkov, V. P., A. S. Ushakov, Yu. I. Kondrat'yev and A. G. Kasatkina, "Emergency Sypply of Dry Products in a Polymer Pack," *Voyenno-Meditsinskiy Zhurnal*, No. 10, pp. 70-73, 1963. /18

In order to save lives and insure the working capacity of an individual who has fallen into an emergency situation at sea, in an aircraft or during space flights, rations with minimum weight and volume are being developed and used. The principles for their development are different. O. P. Molchanova et al recommend maintenance of normal ratios between the basic nutrient substances. P. Ye. Kalmykov and L. N. Logatkin recommend diets with an increased content of protein and vitamins. L. N. Komarovtsev et al express a preference for carbohydrates.

The authors devised an emergency three-day ration, provided with maximum biological value with minimum weight and volume. The authors selected lyophilized products for their diet: milk, cream, cream cheese, cheese, meat, from which the moisture was removed under a vacuum in the frozen state. This method makes it possible to retain the original nutrient and taste characteristics of the products. A number of mixtures were prepared: No 1 -- cheese, cream cheese, milk in proportions of 1:1:1 (150 grams); No. 2 -- cream cheese, cream, sugar, 5:5:1 (110 grams); No. 3 -- cream cheese, nuts, milk, sugar, 5:5:11:1 (220 grams) and No. 4 -- beef, white sugar, cream cheese, 6:4:5 (300 grams). In addition, the mixture contained 300 grams of chocolate, 300 grams of sugar and 18 dragees of polyvitamins (A-1650 AK, B_1 - 1 mg, B_2 - 1 mg, C - 25 mg in each dragee). The weight of the ration was 1475 grams, the caloric content was 6950.0 kcal, the protein content was 241.0 grams, fat -- 338.8 grams, carbohydrates 685.8 grams. The products packed in a plastic film, were divided into /19
three one-day batches. Each daily batch contained four portions of tablets of the mixture -- breakfast, brunch, lunch and dinner. The ration was tested under laboratory conditions on four subjects for three days. Three of the subjects lost weight (about 1 kg on the average), while the weight of the fourth subject did not change. There were no changes of any kind in the urine as far as the nitrogen, phosphorus, or urea content was concerned.

Volovich, V. G., *God na Polyuse* [A Year at the Pole], Moscow, Sovetskiy Press, 1957.

The Soviet drifting station North Pole 3 was set up on the ice in the Central Polar Basin in March 1954. In the course of a year, the Soviet investigators carried out their scientific work under the harsh conditions of the arctic. The book is based on the material from the diaries of a member of the expedition and tells about the difficult working days of the collective of researchers. Individual chapters deal with the scientific problems and tasks of the station. A special chapter is devoted to the jump made by Soviet parachutists onto the drifting ice in the vicinity of the North Pole. The possibility of making parachute jumps onto the ice of the Central Polar Basin makes it possible to use this method for bringing doctors to an area where the crew of an aircraft has been forced to make an emergency landing. The use of paramedics in such situations makes it possible to render necessary medical assistance to

victims in a very short time, even at great distances between the accident site and the home bases and airports.

Volovich, V. G., "A Jump at the North Pole," *Sportivnay Zhizn' Rossii*, No. 11, pp. 22-23, 1961. /20

In May 1949, Soviet parachutists A. Medvedev and V. Volovich, who was a physician, made parachute jumps to the drifting ice in the vicinity of the North Pole. This demonstrated not only the theoretical possibility of making parachute jumps in the vicinity of the Central Polar Basin, but also of using parachutes to bring physicians quickly to the crew of an aircraft which has crashed when making a forced landing in the central arctic. The doctor, equipped with special supplies, medicine and bandages, can render the necessary medical assistance in a very short space of time, taking measures to save life and preserve the health of the victims.

Volovich, V. G., *Tridtsatyy Meridian* [The Thirtieth Meridian], Moscow, Molodaya Gvardiya Press, 1967

Every year the Soviet Union sends out expeditions to explore the world ocean. The book tells about one of these expeditions aboard the scientific research vessel "Mikhail Lomonosov." A number of chapters deal with scientific problems faced by oceanologists, meteorologists, marine microbiologists, etc. Individual pages of the book are devoted to the problem of survival and rescue of men who are at sea aboard rescue flotation devices. The author discusses some of the problems of human survival under conditions of independent existence at sea, including the possibility of using sea water for drinking, the behavior of man in emergency situations at sea, the influence of environmental factors on the human organism, etc. In a special chapter the author /21 discusses the status of the problem of protection of man against attacks by sharks, etc. The multiple aspects of the problem of human survival at sea following a crash landing of a spacecraft or the forced landing of an aircraft requires careful study and the development of effective methods and means which will insure human survival in the tropical zone of the ocean.

Volovich, V. G., "On a Raft on the Ocean," *Vokrug Sveta*, No. 11, pp. 2-9, 1969.

Rescuing the crew of a ship after a wreck or the crew of an aircraft which has made a forced landing at sea is an important problem in conjunction with the considerable difficulties of independent survival of individuals aboard lifeboats and rafts. The high temperature of the air and water, the considerable solar radiation, the constant rolling, difficulty in obtaining water and food -- all of these exert strong limitations on the survival period of victims at sea. In order to solve a number of these problems associated with this area, a group of research physicians carried out natural experiments in the tropical zone of the ocean. Ten participants in the experiment spent 5 days aboard a liferaft far from the mother ship, using an emergency with low caloric content

for nourishment. The daily ration of water was limited to 1 liter. Each day all of the subjects carried out a medical checkup. They determined the functioning of the state of the cardiovascular system, body temperature, muscle tone, and gas exchange. They measured the content of K, Ca, A, chlorine, P, etc. in /22
the samples of daily urine. Analyzing the Soviet and foreign data on the use of sea water for drinking, the author supports the view of its unsuitability for drinking due to the toxic effect of the salts which it contains on the human organism. Marine predators constitute a serious danger for those shipwrecked at sea, and sharks are the most important of these. Tests of a repellent consisting of a mixture of nigrosine and copper acetate indicated that this substance was ineffective. The author expresses his views concerning the ineffectiveness of powdered repellents due to the impossibility of instantaneous application, rapid use during attack by sharks, etc. The article is illustrated by examples which are indicative of the importance of preliminary preparation and training of the crews in the rules of behavior under the conditions at sea. Knowledge of the protective measures to be taken against the action of unfavorable environmental factors, ways of obtaining food, etc. considerably ease the existence of individuals who have been forced to remain at sea aboard rescue flotation apparatus.

Volovich, V. G.,and V. N. Uskov, "Some Questions of Water Exchange in Man Under Conditions in the Tropical Zone of the Ocean," *Voyenno-Meditsinskiy Zhurnal*, No. 6, pp. 50-52, 1967.

The problem of independent existence and survival of crews and passengers of aircraft and ships that have met disaster in the open sea is a very timely one. In a case of crash of an aircraft or the wreck of a ship the individuals /23
are faced with a one-to-one struggle against the watery element, and this struggle calls for skill, strength, and great courage. An inadequate supply of liquid for the affected organism can bring an individual to the brink of catastrophe (Adol'f et al, 1952) or can lead to a sharp decrease in his physical and psychic activity and thereby limit the possibility of fighting for life under conditions of independent flotation. The problem of obtaining water can be solved in two ways: on the one hand, by obtaining drinking water through distillation of the sea water and collecting rain water or dew, and on the other hadn by observing the correct modes of behavior and utilization of various methods of protection against overheating (tents to protect against the sun, moistening of the clothing, etc.). This is why particular emphasis is placed on measures directed at reduction of water loss due to perspiration. While cruising in the tropical zone of the ocean in the summer of 1964, the scientific research vessel "Mikhail Lomonosov" conducted studies of water loss in man under various conditions using volunteer subjects. The experiments were conducted for a period of 3 hours (from 0900 to 1200) on an open space on the deck, shielded from the wind. Water losses were determined on the basis of the difference in body weight before and after the experiment. During the experiment the subjects did not drink any water and did not urinate. The air temperature during the first experiment was between 25 and 27°C with a relative humidity of 75-65% and a wind speed of 0.5-1 meter per second. The temperature according to the spherical thermometer was 35-39°C. After three hours of the experiment the subjects had lost 1-1.8 kg in weight through perspiration.

A second experiment was performed under similar meteorological conditions, but in contrast to the first, two subjects out of five were beneath a tent made of white kapron cloth. The water losses in the individuals beneath the tent were /24
0.6-0.8 kg, and 0.9-1 kg in the three others. In subsequent experiments, with meteorological conditions similar to the previous ones, water losses were determined in individuals dressed in khaki-colored cotton overalls. Those persons who were dressed in dry overalls lost 0.7-1 kg in three hours. When the overalls were regularly moistened with sea water, the water loss in the subjects was only 0.5 kg in three hours, regardless of the fact that the temperature according to the spherical thermometer was higher than in the previous experiments by 8-10° and reached 49°C.

In 1967 similar tests were performed in the tropical zone of the Indian Ocean. In one experiment four subjects dressed in cotton shorts were on the deck for three hours at locations that were not shielded from the sun. The air temperature varied from 28-29° and 45-50°C according to the spherical thermometer. Under these conditions, the water losses were 1-1.65 kg. In the following experiment the subjects, in addition to having shorts on, were dressed in white tricot cotton shirts. Although the air temperature was 28.3-29.6°C and 45-57° according to the blackened thermometer, the weight losses as a result of perspiration were 0.95-1.6 kg. In order to trace the dynamics of water loss, observations were conducted during the next experiment during the entire daylight period (from 0900 to 1800) with hourly weighing of the subjects who were dressed in light tricot cotton trousers and white tricot shirts. The clothing was not moistened. The air temperature was 25-26.8°, the relative humidity was 71-77%, the temperature according to the spherical thermometer was 37-46°. The total weight losses varied from 1.35-3.15 kg. The majority of these losses occurred between 1200 and 1500, the time of maximum intensity of solar radia- /25
tion. It is clear that at these times it is necessary to try to achieve maximum reduction of physical activity and it is absolutely necessary to protect the skin by clothing or a tent.

Volovich, V. and A. Vsevolodov, "Plus 46 in the Shade," *Vokrug Sveta*, No. 1, pp. 2-6, 1969.

The survival of the crew of an aircraft or spacecraft which has made an emergency landing in an uninhabited area or has splashed down in the ocean is determined primarily by the degree of exposure of the human organism to climatic-meteorological environmental factors, the possibility of replacing the stores of water and food, and the readiness of the crew to take measures appropriate for conditions of independent existence. The study of these problems under natural conditions is necessary in order to obtain data on the physical and psychological limits of tolerance of the human organism, the development of methods of protection against extreme environmental factors, etc.

The study of the conditions of existence of the crew of an aircraft in the desert was carried out by a group of researchers in the deserts of Central Asia. Research physicians spent several days in the desert under a tent made of a parachute at an air temperature of 46-48°C in the shade. Each subject had

a small emergency food ration, a 2-2.5 liter water supply and emergency equipment included in the materials of the PES -- the portable emergency supply.

Regardless of the severe climatic conditions and the extremely limited water ration, the researchers performed all of the studies planned by the experimental program. Limitation of physical activity during the day, use of the tent made of the parachute for protection against the sun, a rational water regime -- all of these promoted an increase in the period of survival of man in the desert with small water supplies. The results of the experiment made it possible once again to emphasize the importance of preliminary training of the crew of an aircraft with an eye toward questions of survival in uninhabited areas. This not only makes it possible to behave correctly under conditions of independent existence but also increases the confidence of the individual in its favorable outcome. /26

Volynkin, Yu. M., Yu. A. Gagarin, A. M. Genin,et al, "A Portable Emergency Supply," *Pervyye Kosmicheskiye Polety Cheloveka* [The First Manned Space Flights], USSR Academy of Sciences Press, pp. 55-56, 1661.

In the event of a premature landing of a spacecraft outside the designated area and coming to earth in an uninhabited area, cosmonauts have been equipped with a PES -- a special portable emergency supply. The PES includes methods of signalling and communication making it possible to establish two-way communications over a distance of several thousand kilometers, as well as to send signals to search aircraft for showing the cosmonauts his location. The emergency food ration was designed for several days of independent existence.

Its composition follows necessary physiological standards. The water supply in the PES was sufficient for covering the minimal physiological requirements of the organism in case of a landing in the desert. In addition, in the event of a splashdown in the sea, the PES was equipped with special briquettes for chemical distillation of water. When landing in the sea, the cosmonaut can use the inflatable raft that comes with the kit. Its design insures rapid automatic filling with air and good stability. Among the objects that are necessary under camping conditions, the PES includes a portable folding hotplate with dry fuel briquettes which can be used to prepare food and drink when there is no local fuel at hand. To make fire the cosmonaut can use special water and wind resistant matches. The PES contains a small medicine chest with a supply of bandages and medicines which are necessary for rendering first aid. In order for the cosmonaut to determine his point of landing, the kit contains a specially designed sextant, large-scale charts and a compass. The set of equipment was placed in a soft container with a frame which was mounted in the base of the ejection seat. The system for fastening the PES was connected to the circular strap of the parachute shroud and remained with the cosmonaut when the seat separated. A special device disconnected the PES if it interfered with the landing of the cosmonaut. /27

Volynkin, Yu. M., A. M. Genin, O. G. Gazenko, V. G. Volovich et al, "Finding the Landing Site of the Cosmonauts," *Pervyy Gruppovoy Kosmicheskiy Polet* [The First Group Space Flight], Moscow, Nauka Press, pp. 104-107, 1964.' /28

A special parachute group was formed, composed of paramedics, for meeting the cosmonauts at the landing site and rendering rapid medical assistance in case of necessity. The physicians were responsible for a special kit which contained medicines, bandages and instruments, necessary for rendering immediate medical assistance. The task of the paramedics also included performance of a medical examination of the cosmonaut at the landing site. During the space flight of cosmonauts A. Nikolayev and P. Popovich the paramedics were allowed to make their jump 15 minutes after the spacecraft landed which made it possible to obtain some interesting scientific data on the state of the human organism following space flight in the shortest possible time after its termination.

Volynkin, Yu. M., A. M. Genin, O. G. Gazenko, V. G. Volovich et al, "The Results of the Medical Examination of Bykovskiy. The Results of the Medical Examination of Tereshkova," *Vtoroy Gruppovoy Kosmicheskiy Polet* [The Second Group Space Flight], Moscow, Nauka Press, pp. 181-200, 1966.

In order to ensure rapid medical aid to the cosmonauts in the event of necessity following landing and the performance of a medical checkup at the landing site, the paramedic groups included individual parachutists equipped with special medical kits. The doctors were dropped at the landing site of the spacecraft and immediately carried out medical examinations in accordance with the program directly on the spot. /29

Gorlov, O and V. Borisov, *Zhizn' i Kosmos* [Life and Space], Moscow, Sovetskaya Rossiya Press, 1961.

The book presents materials on the medical and biological problems of manned flights in space. In the chapter entitled "Emergency Supplies" the authors discuss the need for supplying the cosmonauts with a group of necessary things, water and food supplies, etc. in the event of an emergency landing outside the specified area in order to ensure independent existence in various geographic zones. The portable emergency supply must be universal and must contain supplies for any climatic conditions.

Gur'yanov, A. A., "Evacuation of the Injured from Forest Massifs by Helicopter," *Voyenno-Meditsinskiy Zhurnal*, No. 1, pp. 13-16, 1966.

The search for the crew of an aircraft which has made a forced landing in a forested area involves a number of difficulties. Usually the search is carried out using the method of convergent squares. In winter, the altitude at which human beings can be detected is 400-600 meters while in summer it is 250-150 meters. Under summer conditions the task of evacuation by going in on foot is quite difficult. Hence, it is desirable to find a landing site not far /30

distant from the crash site. In the case of a lack of such an area, the helicopter must hover above the tops of the trees, but no lower than 5-10 meters. A system of signals must be worked out in advance with the ground for correct communications between the rescuers and the rescued.

The rescue helicopter is equipped with an emergency first aid kit with the necessary equipment, water supplies and food. The weight of such a kit is 25-30 kg.

Komarevtsev, L. N., S. D. Kumanichkin and Ye. P. Pobol', "Feeding the Crew of a Spacecraft Under Emergency Conditions," *Voyenno-Meditsinskiy Zhurnal*, No. 1, pp. 74-77, 1960.

In working out an emergency diet it is necessary to proceed not only on the basis of maximum caloric content with minimum weight, but also the correct and normal functioning of all organs and systems. We know that the need of the organism for fats is compensated by the fatty deposits, so that it is most advantageous to introduce to the ration readily assimilated carbohydrates, aminoacids and vitamins.

The authors performed studies with a carbohydrate ration using 16 sailors who spent 4 days on inflated rafts at sea at an air temperature of 14-19° and a water temperature of 15.5°. In the first day of the experiment the subjects who were in 3 rafts did not receive food. Beginning on the second day the /31
crew of the first raft (No. 1) were each given 50 grams of sugar(per day) and 100 grams of vitaminized candy drops containing 225 mg of vitamin C, 5 mg of B_1, 5 mg of B_2, 2.5 mg of B_6, 10 mg of PP, 25 mg of folic acid, 2.5 mg of pantothenic acid, and 10 mg of paraaminobenzoic acid. The total caloric content of the ration was 600 kcal. The rations of the subjects in the second raft (No. 2) consisted of 150 grams of English candy drops made of maltose (600 kcal). The crew of the third raft (No. 3) received concentrates, bread, butter, receiving 1700 kcal per day. Water consumption of all the participants in the experiment did not exceed 0.5 liter per day. The medical examination of the subjects included the following: measurement of the pulse, arterial pressure orthotest, determination of the static tolerance, weighing, determination of adequate optical chronaxia. The content of total nitrogen, aminoacids, creatinine, vitamins,[word misspelled] oxygen, chlorides and acetone was determined in the daily urine. The studies showed that although the subjects aboard raft No. 1 lost more weight than the others (4.5 kg on the average in comparison with 3.7 in the case of No. 2 and 0.5 kg in the case of No. 3, they showed a more pronounced decrease in the nitrogen, aminoacids and total nitrogen in the urine at the end of the experiment, indicating a better retention of proteins by the organism, as well as improved vitamin saturation as a result of active vitaminization. Hence, the conclusions of the experiment show that under these conditions the most rational diet is one that consists of 50 grams of sugar and 100 grams of vitaminized candy drops per day.

Logatkin, M. N., "Some Characteristics of the Utilization of Endogenic Fat During Partial Starvation and Physical Stress," *Voprosy Pitaniya*, No. 5, pp. 27-33, 1963. /32

With improper nutrition on a low calorie diet utilization of endogenic fat is accompanied by the formation of unoxydized products: acetone, acetoacetic acid, betaoxyoleic acid. During starvation their amounts increase. The author conducted 16 10-day experiments in which 10 individuals took part. They received a food ration having a caloric content of either 400, 700, 900 or 1000 kcal per day, and carried out work of moderate difficulty at the same time. The 1000 kcal ration was taken as the standard, composed of 100-130 grams of protein, 60-70 grams of carbohydrates and 30 grams of fat. In individual experiments the protein was replaced by an equivalent amount by weight of sugar. When the sugar was omitted from the ration, up to 1700 mg of acetone appeared in the urine of the subjects (more than 100 times greater than normal).

When fed a protein-fat ration (pemmican), the amount of acetone in the urine reached 653.0 mg. When 36 grams of carbohydrates were added to the ration, ketonuria decreased to 211.0 mg. Addition of 60-70 grams of carbohydrates decreased the amount of acetone in the urine to 42-82.0 mg. We know that the intake of 1 gram of sugar prevents the formation of ketonic bodies from 4 grams of fat. Calculations showed that with energy expenditure of 3500 kcal and feeding with a ration having an energy value of 1000 kcal the energy deficit is 2500 kcal and approximately 280 grams of lipogenic fat was consumed from the deposits. Consequently the optimum ratio between carbohydrates and fats (1:4) required the intake of 70 grams of carbohydrates. An increase /33
in carbohydrates will not make any difference later on. With purely carbohydrate diet no acetonic bodies are observed in the urine. The dynamics of the appearance of acetonic bodies in the urine of the subject was distinctive. It was absent for the first 2-3 days, increased rapidly for 3-6 days and then decreased once more. The most significant changes were observed on the third-fourth days of the experiment when the organism apparently switched over to an intensive utilization of its fat supplies. Subsequently the familiar correlation of the process appeared. It is interesting that administration of oxygen led to a decrease in the number of ketonic compounds in the urine. This indicated that one of the reasons for ketonuria was a shortage of oxygen.

Matuzov, N. I., "The Possibility of Human Survival at Sea Without Supplies of Food and Water," *Gigiyena i Sanitariya*, No. 5, pp. 76-81, 1961.

Human survival at sea aboard liferafts following a disaster is a function in particular of the presence of supplies of fresh water. In addition, the possibility of replacing them at sea is very limited. Numerous experimental papers have demonstrated the impossibility of using sea water for drinking due to the high content of various salts in it. To excrete them, it is practically necessary for the body to use up all of the water which has been drunk. Attempts to use sea water mixed with fresh have not given desirable results. However, such a mixture in the ratio of 2:5 can be used in the event of considerable loss of salts with vomited material in rough seas. It is possible to satisfy the needs of the organism by means of juice taken from the flesh of

fish (fish juice). The flesh of fish can also serve as a source of vitamins A, B and D. The possibility of satisfying the need of the organism for vitamin C through the use of plankton is highly problematical due to its low content in the plankton. This is supported by the author's research which was concentrated on analyzing samples of plankton that were collected from depths of 0-190 meters to determine the content of ascorbic acid. Thus, 3 of the 7 samples showed no vitamin C at all, it was present in amounts from 1-3 mg in 3, and was 8 mg % in only one. In addition, many planktonic forms are toxic to the human organism. /34

Matuzov, N. I., "Some Problems of Saving the Lives of Those Who Have Suffered Disasters at Sea," *Voyenno-Meditsinskiy Zhurnal*, No. 7, pp. 63-68, 1961.

The problem of rescuing human life during an accident at sea remains as timely as ever. The most important question of human survival under conditions encountered aboard rescue flotation devices is the supply of drinking water. Sea water, as we know from many research papers, is unsuitable for use due to its high content of salts that are dissolved in it (up to 30-36 mg %). A large portion of the water drunk by the organism is used to get rid of the excess salts. The author presents large amounts of data from the literature that indicate the negative influence of sea water on a number of organs and systems. The experimental data are supported by the statistics on lethal outcomes following shipwrecks among individuals who have drunk sea water. In addition, the author presents some examples of the use of sea water by victims of shipwreck. The author states that sea or ocean water can be drunk mixed with fresh water in the event that it is necessary for the organism to make up losses incurred through vomiting. The author evaluates the possibility of using fish /35 for drinking. One kg. of juice contains up to 100 grams of protein, 320 millimoles of salt and 900 milliliters of water. The latter is quite sufficient for cleansing the organism of the intake of salts, while 100 grams of protein will provide an additional 410 kcal of energy. In addition, the meat of fish serves as a source of vitamins A, B and D. As far as C is concerned, a number of researchers have recommended that plankton be used as a source of ascorbic acid. The author conducted studies of samples of plankton to ascertain their Vitamin C content using the method of titration with 2, 6-dichlorophenolindophenol. The samples were collected from a depth of 0-190 meters. No vitamin C at all was found in 3 of the 7 samples, its content in 3 did not exceed 019-3 mg% and it was only 8 mg% in one. To satisfy the vitamin needs of the organism in this fashion it would be necessary to have no less than 500 grams of plankton. The use of such an amount of plankton would lead to irritation of the gastrointestinal tract. In addition, there are many planktonic forms that possess high toxicity. In summing up, the author states that prolonged isolated drifting on the sea is possible with experience and knowledge which will ensure successful vital activity during isolated existence.

Merenov, I. V. and A. L. Shmukler, *Naduvnye Spasatel'nye Sredstva Na More* [Inflatible Rescue Devices at Sea], Moscow, Voyenizdat, 101 pp., 1963.

Accidents involving ships and aircraft at sea required a development of various measures to ensure the rescue of the crews at sea. To preserve human life, rescue devices must do the following: keep the victims afloat, protect /36 them against the action of hostile environmental factors, and provide food and water. The book describes modern means of rescue at sea: boats, rafts, life jackets. The book consists of four chapters.

The first discusses general facts concerning existent rescue devices. The second chapter tells about their design, systems for filling them with gas, supplies and equipment, information on how to use them, stow them and accomodate them.

The third chapter is devoted to a description and design considerations of inflatable life jackets (types ISS and SAZH) and the NSN life jacket.

In the fourth chapter the authors discuss the problem of human survival aboard floating rescue craft. Recommendations are given for the behavior of the individuals who find themselves under conditions of independent existence at sea, the food and water ration, and recommendations are given for measures to be taken to protect oneself against the influence of unfavorable environmental factors. Comments concerning the use of inflatable rafts and methods for coping with danger are very important, together with questions of landing the rafts and going ashore. In a special subsection of the chapter the authors describe the measures for rendering assistance in the case of traumas, drowning, etc.

A special table presents the characteristics of the existing types of liferafts: PSP-6, PSN-10 and PSN-20.

Pyneye, N. K., *Deystviya Ekipazha Samoleta, Vynuzhdenno Popavshego v Bezlyudnuyu Mestnost'* [The Actions of the Crew of an Aircraft Forced to Land in an Unpopulated Area], Moscow, Voyenizdat, 195 pages, 1957. /37

This book present information in a popular form that includes recommendations and practical advice for the crews of aircraft forced to make a landing or evacuate the plane by parachute in uninhabited areas. The book consists of four chapters. In the first, "Action of the Aircraft Crew During a Forced Landing or Abandonment of the Aircraft in the Air in Unmanned Areas, Far from Population Centers and Their Own Base," the principal rules for behavior prior to the forced landing or leaving the aircraft by parachute are set forth; specific advice is given as to the actions of the crew both aboard the craft and during descent by parachute and after landing. Separate sections of the chapter include recommendations of how to give oneself and others first aid, how to orient oneself in the area, and how to use signalling and communication devices.

The second chapter, "Characteristics of the Action of the Crew of an Aircraft Following an Energency Landing in Areas with Various Natural and

Climatic Conditions," presents a description of climatic and geographic conditions of the polar regions, taiga and forested-swampy regions, steppes, desert and mountainous areas. The authors emphasize the specific nature of each of these zones, characterize the plant and animal life, dealing separately with the characteristics of survival, methods of constructing shelters from the materials at hand, methods of obtaining food and water, behavior when making exploratory trips, and measures for protection against disease. The third /38
chapter, "Actions of the Crew During a Forced Landing or Jump at Sea by Parachute," is devoted to questions of survival following splashdown. The fourth chapter, "Organization of Search Parties for the Crew Which Has Not Returned to Base and Measures for Rescuing Them," tells about all the measures aimed at finding and aiding the crew that have suffered the accident. The chapter discusses methodology for collecting necessary data for taking measures in the search, a list is provided of equipment and supplies for the search aircraft and heli opters, the tactics they should use, a description of the organization and equipment of ground search parties, etc. The book is illustrated with numerous diagrams, tables and figures.

Udalov, Yu. F., "A Ration with Minimum Weight," *Voyenno-Meditsinskiy Zhurnal*, No. 3, pp. 62-64, 1961.

Minimum weight rations are particularly necessary for the crews of aircraft in the event of landing in uninhabited areas. In designing an emergency ration for northern latitudes it is necessary to maintain the principle of its maximum food value with retention of the weight and dimensions used as guidelines in assembling the kit.

In contrast to the official ration, the experimental one saw an increase in the protein content from 141.1 to 184.5 grams, fat from 179.8 to 279.8 grams. The caloric content of the ration was increased from 4654.0 to 5930.0 kcal. The amount of carbohydrates in the ration was decreased from 711.4 to 627.6 grams. Increasing the caloric content in the experimental ration was achieved /39
by increasing the amount of fats and decreasing the content of moisture in the products. The official and the experimental rations were tested under laboratory conditions using 4 subjects for 7 days. The participants in the experiment were subjected to a study of the daily excretion in the urine of total nitrogen, ammonium nitrate and acetonic bodies. Gas exchange was determined at rest, together with the sugar content in the blood, lipoid phosphorus and cholesterol. When fed a normal ration, the weight loss in 7 days was 1.9-3.5 kg; when the experimental ration was given, it was 1.2-2.9 kg. When the experimental ration was fed, the subjects showed a reduced excretion of nitrogen (30 grams in comparison with 50 grams for the standard ration), which indicated a more rational protein metabolism.

Feeding the subjects with a ration having an increased fat content failed to produce any disturbances of fat metabolism and there was no change in the blood sugar.

The experimental ration was then tested under natural conditions in polar areas on 20 individuals. The natural studies confirmed the findings that were

made in the laboratory. The weight losses were less in individuals with a rather high working capacity, regardless of the rather rigorous conditions of the natural experiment. Consequently, emergency rations must be designed with the maximum useful substance.

Chelushkin, K. A., A. A. Gur'yanov, L. Ya. Lokhmakov and A. A. Mel'nik, *Evakuatsiya Ranenykh i Bol'nykh s Korabley VMF i Trudnodostupnykh Mest Vertoletami* [Evacuation of the Wounded and Sick from Navy Ships and Inaccessible Places by Helicopter], Sevastepol', 1959. /40

The book contains information on searching for and rendering assistance to members of the crews of aircraft and helicopters following a crash or forced landing.

The authors carefully describe the equipment of the search helicopters, methods of using helicopters and aircraft for search and evacuation missions. Parts of the book are devoted to data on how to conduct a search under difficult terrain conditions; in the forests, swamps, at sea, on drifting ice. The tactics to be used by the crews of the search helicopters during evacuation of injured from forest massifs, etc. are described.

STANDARD TITLE PAGE

1. Report No. NASA TT F-15,047	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle MEDICAL ASPECTS OF THE SAFE DESCENT AND LANDING OF A SPACECRAFT ON THE EARTH AND OTHER CELECTIAL BODIES		5. Report Date August 1973 6. Performing Organization Code
7. Author(s) V. G. Volovich		8. Performing Organization Report No. 10. Work Unit No.
9. Performing Organization Name and Address Techtran Corporation P.O. Box 645 Silver Spring, Maryland 20901		11. Contract or Grant No. NASw-2485 13. Type of Report and Period Covered Translation
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		14. Sponsoring Agency Code

15. Supplementary Notes

Translation of "Meditsinskiye aspekty bezopasnogo spuska i posadki korabley na zemlyu i drugiye nebesnyye tela," Vol. 3, Part 4, Chapter 3 of: Osnovy Kosmicheskoy Biologii i Meditsin [Foundations of Space Biology and Medicine], Moscow, Academy of Sciences USSR, 1973, 40 pages.

16. Abstract

The chapter presents a survey of various Soviet sources dealing with survival of pilots, sailors and cosmonauts in uninhabited areas, such as deserts on land, the open sea. Detailed abstracts are presented for a number of papers, and the results of tests to determine feasibility of using sea water for drinking and a number of attempts at determining the optimum composition of emergency rations for use by shipwrecked sailors and pilots or cosmonauts whose craft has landed in the sea or in the desert are presented. It is the Soviet author's opinion that powdered shark repellent is ineffective due to the relatively long period of time required for it to dissolve.

17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	~~22~~ 25	3.25

NASA-HQ